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RATE AND FREQUENCY OF POULTRY MANURE ON GROWTH AND YIELD OF FLUTED PUMPKIN (*Telfairia occidentalis* HOOK. F.)

***[1]O. H, AKINTOYE, [1]J. N. ODEDINA, [2]E. A, MAKINDE AND [3]S. O. ADIGBO**

[1]Department of Plant Physiology and Crop Production, Federal University of Agriculture, Abeokuta, Nigeria
[2]Department of Horticulture, Federal University of Agriculture, Abeokuta, Nigeria
[3]Institute of Food Security, Environmental Resources and Agricultural Research, Federal University of Agriculture, Abeokuta, Nigeria
***Corresponding Author**:oluwatomilayo_me@yahoo.com **Tel**:

ABSTRACT

Cultivation of Fluted pumpkin (*Telfairia occidentalis* Hook. F.) is predominantly done by smallholder farmers but scarcity and high cost of inorganic fertilizers have limited its usage and shifted to viable alternatives. Field experiments were carried out in the Crop Research Farm, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria from November 2018 to August 2019 and from August 2019 to August 2020 cropping seasons to determine the effects of poultry manure (PM) rate and frequency of application on agronomic performance of fresh shoot, pod and seed yields of *Telfairia occidentalis*. There were three rates: 5, 10 and 15 t· ha^{-1} of PM and a control (no application) as main plot and four frequency of PM application: once, twice, three times and at every harvest plot laid out in split -plot arrangement and fitted into a Randomized Complete Block Design, replicated three times. Results showed that in 2018, PM at 15 t· ha^{-1} increased fresh shoot weight at 6 to 14 weeks after sowing (WAS) relative to 5 t.ha^{-1} and 10 t.ha^{-1} PM rate. In 2018, pod weight/plant was increased with 15 t.ha^{-1} PM application and increased with frequency of PM application at every harvest while the seed weight/ plant was increased at 15 t·ha^{-1} PM application and at every harvest. In 2019, pod yield and seed weight increased at 15 t·ha^{-1} PM application while pod yield was increased with no PM application; seed weight/plant increased with PM application three times. In 2019, interaction of PM at 5 t·ha^{-1} applied three times significantly increased fresh shoot weight by 85.4 % at 14 WAP relative to 15 t·ha^{-1} PM applied once. Interaction of PM at 10 and 15 t·ha^{-1} applied three times and at every harvest, respectively gave similar results on cumulative fresh shoot weight while the plants from control plots produced significantly lower fresh shoot weight in 2018. There were no significant differences observed in weight of pod and seed weight/plant with PM rate, frequency and interaction in 2018 and 2019 croppings. Application rate of 10 t·ha^{-1} PM applied three times enhanced cumulative fresh shoot yield and therefore suggested for fluted pumpkin growers.

Keywords: Fluted pumpkin; frequency; poultry manure; rate; shoot growth

INTRODUCTION

The genus Telfairia, is a nutritionally important but scientifically less popular member of the family Cucurbitaceae, order Telfaireae (Botanica, 2004). *Telfairia occidentalis* is mainly cultivated in southeastern Nige-

ria and it is used primarily in soups and herbal medicines (Nwanna, 2008). It must be provided with support (stakes); it has a creeping growth habit that spreads across the ground to produce an efficient ground cover against erosion (Horsfall and Spiff, 2005). Vine size at 64 days after sowing could be used as a sex indicator, because female plants are more vigorous than the male plants (Benadine, 2021). Fluted pumpkin is a rich source of protein, oil, vitamins and minerals (Nwite *et al*., 2013). Increased demand for crops and continuous cultivation on the same land for a long time requires the soil to be adequately fertilized. This has become the norm of cultivation. Most farmers who apply fertilizers do so indiscriminately (Beatrice *et al*., 2016). Application of manure has benefits other than delivery of nutrients. Poultry manure application improves the physical properties of the soil. There have been reports on the increase in the vegetative development of crops with fertilizer applications (Akanbi *et al*., 2007). Poultry manure contains more plant nutrients than all other organic manures for the healthy growth of plants (Oyedeji *et al*., 2014). Application of 10 $t.ha^{-1}$ and 15 $t.ha^{-1}$ poultry manure rates has been shown to influence growth and yield parameters of Telfairia (Achebe *et al*., 2014). This implies that the use of organic soil amendments could be means of improving the growth of *T. occidentalis*. Timing of poultry manure application should be scheduled in order to meet crop needs while minimizing run-off susceptibility. The maximum rate of poultry manure that can be applied at one application depends on the salinity threshold the crop can tolerate. Split fertilizer applications help to avoid salt damages to the crop and improve germination rate. Growers get improved returns from fertilizer investments and fertilizer losses can be reduced (Yang *et al.,* 2011). For *Telfairia* plant to complete its life cycle, more than one application of manure may be needed. There is therefore the need to investigate the response to manure rate and frequency of manure application on growth and yield of *Telfairia occidentalis*.

MATERIALS AND METHODS

The trial was conducted in a lowland at the Crop Research Farm of the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria from November, 2018 to August, 2020. Weather data for the experimental period were obtained from the Meteorological Station of the Department of Water Management and Agro-Meteorology, Federal University of Agriculture, Abeokuta. The factors included three Poultry manure (PM) rates: 5, 10 and 15 $t{\cdot}ha^{-1}$ and a control (no application) as main plot. Frequency of PM application: once, twice, three times and at every harvest as sub-plot. The trial was a split plot arrangement in randomized complete block design (RCBD), replicated three times. Soil samples were taken twice (pre- and post-cropping sampling) using the soil auger at the depth of 20 cm. The pre-cropping samples were taken randomly in "W" pattern while the post-cropping samples were randomly taken from every plot. After the random collection, the samples were thoroughly mixed in a bucket and a representative sample was taken for soil analysis. The post sampling analysis which was randomly taken from every plot was mixed and bulked per plot. These were analysed to determine the physical and chemical properties of the soil. A sample of the PM was taken for chemical analysis prior to each application time. At each harvest, portion of the PM used as treatment was taken for analysis because the PM gradually decompose due to length of storage time before usage. Seeds were ex-

tracted from the pods and sowed. Sowing of one seed/hole at a spacing of 1 x 1m was done by laying the seeds flat on the prepared beds on 29th November, 2018 for the first trial. The second trial was sown on 26th August, 2019 on same plots. 'Telfairia' plants that survived at the end of the first trial were counted, and missing stands were supplied to meet plant population per plot in 2019. Mulching was done to conserve soil moisture during the dry season. The plants were staked at 6 Weeks After sowing (WAS) to assist the plant vines to climb for flowering and fruiting. First PM application was done at 3 WAP and subsequently at 2 weeks interval, after every harvest of leafy shoot to assist the germinated Telfairia plants get nutrients needed. Hand - weeding was done around the base of the plants at 6 and 14 WAS. Harvesting of leafy shoot was done five times at intervals of 2 weeks from 6 to 14 WAS. Data were collected on: Number of branches/plant; Fresh shoot weight; Weight of pods/plant and Seed weight/pod. Number of branches/plant was taken by visually counting the number of branches on a plant on each plant of the five tagged plant within the net plot. Fresh Shoot Weight ($kg{\cdot}ha^{-1}$) was taken by weighing the cut vines at 50 cm from the soil surface per plot. Cumulative Fresh Shoot Weight ($t.ha^{-1}$) was extrapolated from Fresh Shoot Weight ($kg{\cdot}ha^{-1}$). Weight of pods/plant (kg) was taken by weighing each pod per plant and later extrapolated to weight of pod per hectare ($kg{\cdot}ha^{-1}$). Seed weight/pod (kg) was taken by weighing the seeds extracted from the pod.

Data collected were subjected to analysis of variance, using GENSTAT 12th edition statistical package Copyright 2009, VSN International Limited. Significant means were separated using LSD at 0.05 level of probability.

RESULTS

Rainfall was higher in 2019/2020 relative to 2018/2019. In 2018/2019, total rainfall was 930.6 mm, mean temperature was 31.5°C. In 2019/2020, the total rainfall was 1155.2 mm, mean temperature was 27.8°C (Table 1). Soil textural class was loamy sand (Table 2). Across the two years of manure application, pH of the Poultry manure (PM) ranged from neutral to alkaline; the organic matter, total nitrogen and available phosphorus were moderate; the C: N ratio was moderate for the decomposition process. Over the period of PM storage, the pH decreased in 2018, ranging from moderately alkaline to neutral but increased in 2019 to slightly alkaline (Table 3).

In both croppings, there was no significant difference observed on the effect of PM rates except at 6 WAS in 2019 and frequency of PM application and interaction on number of branches (Table 4). At 6 WAS, application of 5 $t{\cdot}ha^{-1}$ PM significantly increased the number of branches/plant relative to treatment with 10 $t{\cdot}ha^{-1}$. Frequency of PM application influenced number of branches per plant throughout the sampling periods in 2018 (Table 4). PM applied at 15 $t{\cdot}ha^{-1}$ significantly increased fresh shoot weight at 8, 10 and 14 WAS relative to 5 and 10 $t{\cdot}ha^{-1}$ PM rate at 8, 10 and 14 WAS in 2018 (Table 5). In 2018, at 8 WAS, PM applied three times significantly increased fresh shoot weight relative to plots that received PM once, twice and at every harvest and from control plots. At 10 WAS, PM applied three times significantly increased fresh shoot weight relative to the control plots and plots that received PM once, twice and at every harvest. PM applied three times significantly increased

fresh shoot weight compared to the control plots at 12 and 14 WAS. In 2019, no significant difference was observed on fresh shoot weight at 6, 8, 10, 12 and 14 WAS. Application of 5 t.ha^{-1} PM increased fresh shoot weight relative to 15 t·ha^{-1} at 6, 10 and 14 WAS. For frequency of PM application, significant differences were observed at 12 and 14 WAS. Plots that received PM three times and at every harvest significantly increased fresh shoot weight relative to plots that received PM once and twice at 12 WAS. PM applied three times significantly increased fresh shoot weight relative to the control plots and plots that received PM once, twice and at every harvest at 14 WAS. There was significant interaction observed between PM rates and frequency of manure application on fresh shoot weight at 8 and 14 WAS in 2018 and at 14 WAS in 2019 (Table 6).

Table 1: Weather data of experimental period for year 2018 to 2020

Month	Max. Temp (^{0}C)	Min. Temp (^{0}C)	Max Temp (^{0}C)	Total Rainfall (mm)	Relative Humidity (%)	Sunshine (Hours)	Evaporation (mm)
				2018-2019			
November	32.9	23.6	28.3	36.0	68.7	4.5	3.4
December	34.7	22.4	28.1	-	58.4	4.3	4.5
January	35.3	22.5	28.8	9.0	64.1	4.1	4.4
February	35.8	23.9	29.9	79.0	57.0	3.4	-
March	34.3	23.9	29.1	59.6	79.2	4.6	-
April	31.7	23.6	27.7	157.6	78.1	5.6	4.4
May	31.7	23.6	27.7	150.4	80.0	4.5	60.0
June	31.0	23.2	27.1	264.5	83.1	3.7	26.4
July	29.3	23.2	26.2	108.7	87.4	2.2	1.5
August	29.6	23.2	34.0	65.8	83.4	2.5	1.6
Total				930.6			
Mean			31.5	116.3			
				2019-2020			
September	30.1	23.1	26.6	96.3	85.7	2.0	-
October	30.0	22.7	26.4	310	84.0	1.7	-
November	32.1	23.8	28.0	112.3	86.9	5.2	-
December	33.9	22.1	29.0	-	81.2	5.1	3.0
January	35.6	19.7	27.8	-	75.4	4.2	4.0
February	37.2	21.6	29.4	-	68.2	7.61	3.9
March	35.3	24.8	30.1	145.1	73.7	7.2	3.2
April	33.5	23.4	29.4	120.0	73.4	6.11	3.2
May	32.2	24.6	27.9	110	78.2	5.8	3.4
June	29.9	22.5	26.6	149.1	81.3	3.96	3.99
July	29.1	22.3	25.7	109.5	82.5	23.34	2.6
August	30.9	21.8	26.16	2.9	79.1	3.21	3.99
Total				1155.2			
Mean			27.8	92.3			

Source: Department of Agro- meteorological and Water Management, Federal University of Agriculture, Abeokuta. (2018 to 2020)

Table 2: Soil physical and chemical properties prior to sowing with fluted pumpkin

Parameter	Value
pH (H_2O)	5.53
Organic carbon (%)	0.88
Organic matter (%)	15.17
Total nitrogen ($g{\cdot}kg^{-1}$)	0.10
Available phosphorus ($mg{\cdot}kg^{-1}$)	4.91
Exchangeable K	0.14
Ca	4.75
Na	0.34
Mg	1.06
Exchangeable Al^{3+} H^+ ($cmol.kg^{-1}$)	0.11
ECEC ($cmol{\cdot}kg^{-1}$)	6.40
Base saturation (%)	98.28
Micro-nutrients ($mg.kg^{-1}$)	
Mn	74.10
Fe	154.6
Cu	0.7
Zn	12.38
Sand (%)	89.2
Silt (%)	5.4
Clay (%)	5.4

Table 3: Chemical Properties of Poultry Manure before and after application

		Application frequency				
Parameter	**Before Application**	**1**	**2**	**3**	**4**	**5**
		2018/ 2019				
pH (H_2O)	8.41	8.27	8.29	7.98	7.16	7.05
Org. M (%)	17.33	20.84	16.91	18.21	8.34	8.71
N (%)	1.5	1.97	1.02	0.89	1.63	1.48
P (mg/kg)	604.37	4980	5910	5730	6619	6418
K (%)	0.43	0.58	0.52	0.48	0.52	0.51
C/N ratio	6.70	6.14	9.62	11.87	2.97	3.41
Ca (%)	6.03	2.01	6.51	5.66	7.83	13.39
Mg (%)	0.14	0.49	0.21	0.17	0.33	0.35
Na (%)	0.11	0.45	0.13	0.15	0.24	0.25
Fe (mg/kg)	35700	2359	32561	28925	876	1258
		2019/ 2020				
pH (1:1 H_2O)	7.60	7.80	6.80	9.40	7.20	8.40
Org. M (%)	5.29	5.87	8.74	9.80	4.27	4.65
N (%)	0.98	0.90	1.67	1.83	0.82	0.85
P (mg/kg)	4160	4910	12180	16210	3580	3920
K (%)	8.82	8.66	2.11	2.26	8.10	8.22
C/N ratio	3.13	3.71	3.04	3.10	3.02	3.20
Ca (%)	6.22	6.76	91.28	98.31	6.01	6.31
Mg (%)	5.73	5.16	62.73	66.92	5.45	5.322
Na (%)	0.68	0.61	68.69	72.12	0.58	0.56
Fe (mg/kg)	1120	1060	1170	1140	1214	1163

Table 4: Effects of rate and frequency of manure application on number of branches/plant of *Telfairia occidentalis*

	6	8	10	12	14	6	8	10	12	14
	Weeks After Sowing									
	2018					2019				
Treatment										
Poultry manure rate ($t \cdot ha^{-1}$)										
Control	4.11	5.20	6.47	8.09	8.93	3.23	2.96	3.89	3.86	4.76
5	3.72	5.01	6.09	7.59	9.70	3.70	3.65	4.07	4.52	5.37
10	4.40	4.79	6.33	8.08	8.80	2.85	3.25	3.19	3.27	4.52
15	4.35	5.69	7.13	8.63	9.99	3.01	3.52	4.56	4.75	5.80
LSD ($p \leq 0.05$)	Ns	ns	ns	ns	ns	0.699	ns	ns	ns	ns
Frequency of Application										
Once	3.67	4.60	6.13	7.38	8.94	3.09	3.49	3.36	4.13	4.59
Twice	4.42	5.33	6.93	8.49	10.12	3.07	3.26	3.72	3.67	4.93
Three times	4.13	5.22	6.44	8.69	9.92	3.26	3.76	4.57	4.91	6.51
Every harvest	4.44	5.47	6.62	7.84	9.56	3.29	3.91	4.17	4.34	5.37
LSD ($p \leq 0.05$)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Rates x Frequency ($p \leq 0.05$)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

ns: not significant

Table 5: Effects of rate and Frequency of manure application on Fresh Shoot Weight and Cumulative Fresh Shoot Weight of *Telfairia occidentalis*

	Fresh Shoot Weight (t·ha^{-1}) Weeks After Sowing					CFSW (t ha^{-1})	Fresh Shoot WeAight (t·ha^{-1}) Weeks After Sowing					CFSW (t· ha^{-1})
Treatments	6	8	10	12	14		6	8	10	12	14	
			2018						2019			
Poultry manure rate (t· ha^{-1})												
Control	100.8	216	272	246	318	1153	289	692	97	218	387	1682
5	91.7	248	298	321	458	1417	452	752	152	280	622	2258
10	120.5	327	439	473	741	2101	344	594	98	86	486	1609
15	144.9	403	570	608	1255	2982	335	759	71	358	400	1923
LSD ($p \leq 0.05$)	ns	114.4	170.8	ns	348.9	921.5	ns	ns	ns	ns	ns	ns
Frequency of Application												
Once	111.8	305	346	392	591	1747	453	720	74	100	466	1812
Twice	121.3	386	447	550	769	2273	241	590	87	139	347	1404
Three times	154.3	396	689	705	1467	3411	473	696	146	431	775	2520
Every Harvest	107.0	329	425	443	945	2249	431	812	131	320	589	2233
LSD ($p \leq 0.05$)	ns	121.4	216.9	263.2	435.6	952.6	ns	ns	ns	235	234.6	ns
Rate x Frequency ($p \leq 0.05$)	ns	27.84	ns	ns	27.85	ns	ns	ns	ns	ns	24.63	ns

ns: not significant, CFSW: Cummulative Fresh Shoot Weight

In 2018 cropping, 15 t·ha^{-1} PM rate applied at every harvest significantly increased fresh shoot weight at 8 WAS compared to other PM rate and frequency of application while application of 10 t·ha^{-1} PM at control plot produced significantly lowest fresh shoot weight (Table 6). At 14 WAS, PM at the rate of 15 t·ha^{-1} applied three times significantly increased fresh shoot weight compared to other application rates and frequency of application, while 5 t·ha^{-1} PM rate at control produced significantly lower fresh shoot weight. In 2019 cropping, at 14 WAS, PM rate of 5 t·ha^{-1} applied three times significantly increased fresh shoot weight relative to other application rates and frequency of application while 15 t·ha^{-1} PM rate applied once produced significantly lower fresh shoot weight (Table 5).

In 2018 cropping, 15 t·ha^{-1} PM rate significantly increased cumulative fresh shoot weight compared to 5 t·ha^{-1} PM rate (Table 5). PM applied three times significantly increased cumulative fresh shoot weight relative to other frequency of application.

In 2018 and 2019 cropping, there were no significant differences observed on weight of pods and seed weight/pod (Table 7). Application of 15 t·ha^{-1} PM increased weight of pods/plant and seed weight/pod while 5 t·ha^{-1} rate produced lowest weight of pods/plant and seed weight/pod. In 2018, PM applied at every harvest increased weight of pods/plant and seed weight/pod relative to the control plot. In 2019, control plots had increased weight of pods/plant relative to PM applied at every harvest while PM applied three times increased seed weight/pod relative to PM applied at every harvest. In 2018 and 2019 cropping, there was no significant interaction observed between PM rates and frequency of application on weight of pod/plant and seed weight/pod (Table 7).

Table 6: Interaction of Rate and Frequency of application on the Fresh Shoot Weight (t·ha^{-1}) of *Telfairia occidentalis*

Poultry Manure Rate (t·ha^{-1})	Frequency of Application	2018	2019	
		Weeks After Sowing		
		8	14	14
Control		216i	318k	386h
5	Once	239h	449j	765b
	Twice	432cd	619g	517e
	Three times	214ij	625g	1156a
	Every Harvest	176k	445j	366i
10	Once	416d	739f	463g
	Twice	344f	907d	250j
	Three times	528b	1185c	492f
	Every Harvest	191jk	574i	589d
15	Once	261g	587h	169k
	Twice	381e	782e	273j
	Three times	444c	2590a	678c
	Every Harvest	619a	1815b	662c
LSD ($p \leq 0.05$)		27.84	27.85	24.63

Table 7: Effects of rate and Frequency of poultry manure application on Pod yield (kg.ha^{-1}) and Seed Weight/Pod (kg) of *Telfairia occidentalis*

	Pod yield (kg·ha^{-1})	Seed Weight/ Pod (kg)	Pod yield (kg.ha^{-1})	Seed Weight/Pod (kg)
	2018		**2019**	
Poultry Manure Rate (t ha^{-1})				
Control	1026	117	4737	156
5	1335	200	1827	147
10	1770	253	1765	97
15	1883	277	5191	223
LSD ($p \leq 0.05$)	ns	ns	ns	ns
Frequency of Application				
Once	1370	194	2620	167
Twice	1295	150	2759	189
Three times	1994	300	3555	194
Every Harvest	2627	456	969	72
LSD ($p \leq 0.05$)	ns	ns	ns	ns
Rate x Frequency ($p \leq 0.05$)	ns	ns	ns	ns

ns: not significant

DISCUSSION

This study has demonstrated that rate and frequency of PM application influenced the shoot, pod and seed parameters of fluted pumpkin. The distribution of rainfall during the growth stages favoured better growth and development of Telfairia especially for PM fertilized plots in both cropping seasons, which was reflected in the cumulative fresh shoot weight. Rainfall and hence soil moisture status plays an important role in maximizing the yield potential of crop which is in conformity with the findings of Irmak *et al.* (2016) who reported that soil-water in the plant root-zone must be maintained in a balance so that plants can optimize their transpiration (biomass/yield production process) as well as water, nutrient, and micronutrient uptake). The soil of the experimental site was low in fertility and would require amendments for sustainable agricultural yield. The PM had high levels of Total nitrogen, organic matter, iron and phosphorus for mineralization where organic matter decomposition releases nutrients in a plant available form. It equally indicated high moisture retentive capacity, soil aggregation and accommodation of different organisms which are agents of soil fertility (Nwosu *et al.* 2013). The high and wide variation in the

values for phosphorus and iron could be due to the poultry manure high potassium content. It could also be as a result of high accumulation of iron in lowland areas. The number of branches/plant observed increased with increase in PM rate and frequency of manure application in 2018 and 2019 could be due to the fact that the branches were able to exhibit their potential capacity as a result of sufficient nutrients availability. The increased number of leaves/plant confirmed earlier report of Usman (2015) that nutrient availability is a major determinant of the crop photosynthetic capacity. The steady increase of fresh shoot weight could be attributed to the ability of PM at high rate to increase soil nutrients, including organic matter which energized the activities of soil organism to liberate the chemical nutrients needed by *Telfairia occidentalis*. Oyedeji *et al*., (2014) reported that poultry manure contains more plant nutrients than all other organic manures for the healthy growth of plants. Lowest rate of 5 t·ha^{-1} PM enhanced the fresh shoot weight at 6, 10 and 14 WAS in 2018. The residual effect of 5 t·ha^{-1} PM (from 2018 cropping) and the added 5 t.ha^{-1} PM (2019) was adequate for the growth of *Telfairia occidentalis* hence, leading to increase in fresh shoot weight. The luxury application of PM at 15 t·ha^{-1} (accumulated rate) from 2018 cropping thus led to nutrient loss which resulted to a decline in fresh shoot weight of *Telfairia occidentalis*. In both cropping seasons, PM applied three times increased the fresh shoot weight while the control plots resulted in decrease in fresh shoot weight at 6 to 14 WAS. The enhanced growth was due to the fact that PM applied had medium nutrient content and the least performance exhibited by unfertilized plants (control plot) could be attributed to nutrient depletion by cropping, without replenishment. Adeniyan and Ojeniyi (2005) reported that PM made nutrients such as nitrogen and organic matter available as they are essential for plant growth which could lead to higher yields. Fresh shoot weight increased when PM was applied three times and decreased as PM was applied every harvest at 2 weeks interval. The decrease observed maybe due to the absorptive capacity of the soil being overwhelmed with too much manure which is in conformity with (Ntia *et al*., 2017) who reported that too much nitrogen from excess manures can reduce the yield and quality of many vegetables. Application of manures like any fertilizer, can lead to nutrient leaching and pollution of groundwater, so to maximize the economic and fertilizer value of organic manures, their application should match the nutrient needs of the crop (Ntia *et al*., 2017). This trend was observed in 2019 at 10 to 14 WAS. In 2019, application of 5 t·ha^{-1} PM increased cumulative fresh shoot weight. The increase was as a result of residual nutrients added to the soil by carry over benefit of the application on the succeeding crop which is in conformity with (Silva *et al*., 2006) who reported that the residual effect of organic manure applied to the soil refers to the carry over effect of the application on the subsequent crop. PM applied three times increased the cumulative fresh shoot weight. This might be a result of high C: N ratio of the PM and nitrogen being an important nutrient in the production of leaves and shoot of plants which is in conformity with Ayeni *et al*., (2012) who reported that poultry manure contains useful soil nutrients that are needed for growth of plants. For interaction of PM rate and frequency of manure application in 2018, the trend showed that application of 15 t·ha^{-1} PM rate applied three times and at every harvest significantly increased cumulative fresh shoot weight. The increase was as a result of high nutrient availability

for plant absorption. High organic manure application affects soil property improvement in soil quality and ability to supply beneficial nutrients to plant. This is in conformity with the research report from Micheal Okpara University of Agriculture, Umudike (2006 and 2007) that highest fresh and marketable fluted pumpkin leaf yields were associated with poultry manure application (Muoneke *et al*., 2011). Increasing the rate and frequency of PM application enhanced weight of pods/plant (kg·ha^{-1}) and seed weight/pod (kg) in 2018 and 2019. Pod and seed yields increased with increase in rate and frequency of manure application which indicated that the higher quantity of the manure might have supplied the important nutrients and had more effect on the soil chemical and biological properties which is in conformity with Yaru *et al*., (2018) who reported increased productivity from poultry manure amended soils likely indicates that repeated application to cropland has potential to improve soil health characteristics such as soil organic matter and soil fertility. The increase observed for the pod and seed yields could be as a result of the superiority of PM especially when applied in higher quantity, hence releasing and making available adequate nutrients which might have been needed by the crop for the optimum development of the pod. Iwuagwu (2016) reported that availability of sufficient nutrients facilitates the sink function of fruit plants nourished with sufficient amount of nutrients.

CONCLUSION

The study concluded that application of 10 or 15 t·ha^{-1} PM applied three times and at every harvest gave similar result on cumulative fresh shoot weight of fluted pumpkin. The study recommends application of 10 t·ha^{-1} PM applied three times to optimally increase cumulative fresh shoot yield in fluted pumpkin.

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